

We Claim:

1. A communications device comprising:
an Optical domain Adaptive Dispersion Compensation Module (OADCM);
5 an Electrical domain Adaptive Distortion Compensation Module (EADCM); and
a controller coupled to and operable to selectively control both the OADCM and the EADCM.
2. The communications device of claim 1, wherein the
10 controller controls operating characteristics of at least one of the OADCM and the EADCM.
3. The communications device of claim 2, wherein the controller controls the OADCM based on feedback information provided to the controller from the EADCM.
- 15 4. The communications device of claim 2, wherein the controller controls the EADCM based on feed forward information provided to the controller from the OADCM.
5. The communications device of claim 2, further comprising:
an Optical Amplifier with automatic-Gain Control (OAGC)
20 coupled to the OADCM and the controller.
6. The communications device of claim 5, further comprising:
a PIN photodiode detector in combination with a trans-impedance amplifier (PIN/TIA) coupled to the OAGC and the controller.

7. The communications device of claim 1 integrated into an optical signal receiver, wherein the EADCM provides signal distortion measurements to the controller taken from an incoming signal, the controller in turn adjusting the
5 respective operating characteristics of the OADCM, and wherein in operation at least one of the EADCM and OADCM apply dispersion compensation to the incoming signal.
8. The communications device of claim 7, wherein the EADCM provides polarization mode dispersion compensation.
- 10 9. The communications device of claim 7, wherein the OADCM provides chromatic dispersion compensation.
10. The communications device of claim 7, wherein the EADCM includes an equalizer that produces symbol estimates.
11. The communications device of claim 7, wherein the EADCM
15 includes a blind equalizer that produces error values.
12. The communications device of claim 1 integrated into an optical signal transmitter, wherein in operation at least one of the EADCM and OADCM provides pre-emphasis to a transmitted optical signal to substantially overcome dispersion the
20 transmitted optical signal will encounter en route to a receiver.
13. An Electrical domain Distortion Compensation Module comprising:
a Multi-Phase Eye Quality Monitor (MPEQM); and
25 an equalizer circuit.

14. The Electrical domain Distortion Compensation Module of claim 13, wherein the MPEQM comprises:

a clock recovery circuit for retrieving a clock signal from an incoming signal;

5 a first comparator path for comparing a first portion of the incoming signal to a scanning reference, the first comparator path timed according to the clock signal from the clock recovery path;

a second comparator path for comparing a second portion
10 of the incoming signal to an optimal timing reference, the second comparator path timed according to the clock signal from the clock recovery path; and

a difference accumulator for keeping track of the number of instances that respective outputs from the first and second
15 comparator paths differ, as a measure of the eye quality.

15. The Electrical domain Distortion Compensation Module of claim 13, wherein the equalizer circuit is a distortion equalizer.

16. The Electrical domain Distortion Compensation Module of
20 claim 13, wherein the distortion equalizer is a decision feedback equalizer.

17. A method of controlling an Optical domain Adaptive Dispersion Compensation Module (OADCM), the method comprising:

i) measuring signal distortion of an incoming signal in
25 the electrical domain;

ii) processing the signal distortion measurements to produce at least one OADCM control value; and

iii) applying the OADCM control value to the OADCM.

18. The method according to claim 8, wherein the signal distortion measurements are signal quality measurements.

19. The method according to claim 8, wherein the signal distortion measurements are symbol error estimates.

5 20. The method according to claim 8, wherein the signal distortion measurements are error values.

21. A method of translating channel states into a Channel Value (CV) at a time t and state i assuming that a channel has a memory length L :

- 10 i) estimating tap weight-vectors h_1 and h_2 ;
 ii) calculating a CV value according to the equation:

$$\begin{aligned} CV(i,t) = & [\sum a_i(k,t) h_1(L-k-1,t) + on_1(t)]^2 \\ & + [\sum a_i(k,t) h_2(L-k-1,t) + on_2(t)]^2 \\ & + en(t) \end{aligned}$$

15 where, $a_i(k,t) = 000\dots 0$ when $i=0$ at time t ;

$a_i(k,t) = 000\dots 1$ when $i=1$ at time t ;

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$a_i(k,t) = 111\dots 1$ when $i=2^L-1$ at time t ;

 iii) determining a mean square error estimate using the
 20 CV value; and

 iv) determining operation of a controller in the Initialization or Adaptive Control Mode based on the mean square error estimate.

22. A method of Blind Channel Initialization, the method comprising:

- i) calculating tap-weight vectors h_1 and h_2 , each having respective elements;
- 5 ii) operating an Electrical domain Adaptive Dispersion Compensation Module until it reaches a static status;
- iii) Computing a first mean square error value;
- iv) shifting elements of the tap-weight vector h_2 by one element and repeating step iii) to obtain a second mean
- 10 square error value;
- v) repeating step iv) until a first non-zero element reaches an end of tap-weight vector h_2 , thus obtaining a first set of mean square error values;
- vi) shifting the elements of the tap-weight vector h_1 by
- 15 one element and repeating steps iii) to v) to obtain a second set of mean square error values;
- vii) halving the original values of the two left-most non-zero elements in both h_1 and h_2 and repeating steps iii) to vi) to obtain a third set of mean square error values;
- 20 viii) doubling the original values of the two left-most non-zero elements in both h_1 and h_2 and repeating steps iii) to vi) to obtain a fourth set of means square error values;
- and
- ix) Selecting a smallest mean square error value of the
- 25 combined first means square error value, second mean square error value, and the first, second, third and fourth sets of mean square errors values corresponding to values that are best initial values of tap-weight vectors h_1 and h_2 .

23. A method of Blind Channel Initialization, the method comprising:

- i) collecting a set of error measurements corresponding to different permutations of elements belonging to at least
5 one tap-weight vector; and
- ii) selecting a permutation of the elements of the at least one tap-weight vector that corresponds to a minimum error measurement collected in step i).